

**EARLY STAGE EXPERIMENT**  
*Flight Pattern Descriptions*

---

**Experiment/Module:** Stratiform Spiral Module (SSM)

**Investigator(s):** Rob Rogers (PI), Jon Zawislak, Trey Alvey, Robert Black, Josh Wadler, Hua Leighton, Xuejin Zhang, Michael Bell (CSU), Anthony Didlake (PSU), Jim Doyle (NRL), Dan Stern (NRL)

**Requirements:** TD, TS, Category 1

**Early Stage Science Objective(s) Addressed:**

1. Obtain a quantitative description of the distribution of liquid and frozen hydrometeors in stratiform precipitation to better understand the processes that govern these distributions and how they are represented in numerical models [*APHEX Goals 1, 3*].

**P-3 Pattern 1**

**What to Target:** An area of stratiform precipitation outside the RMW.

**When to Target:** When stratiform precipitation is identified either by radar or satellite during the execution of a survey pattern at or near the radius of maximum wind (RMW) of a tropical depression, tropical storm, or Category 1 hurricane. When possible, coordination with a ground scientist should be used to improve situational awareness, as they may have better access to satellite loops, lightning data, etc. that aid identification of precipitation structure. Additionally, it is recommended that the onboard scientists use radar (lower fuselage, i.e., MMR) looping features and/or storm ID tracks if available.

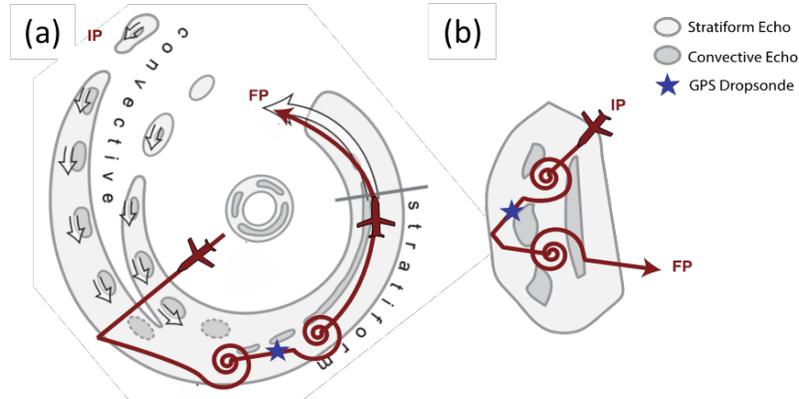
Perform a spiral ascent from low-levels up above the freezing level to make direct hydrometeor measurements with the P-3 cloud and precipitation probes. After a short transect and a dropsonde launch at higher altitude, the P-3 should return to standard flight level via a spiral descent. Safety permitting, the bottom and top of the spiral should be vertically aligned with the aircraft returning to the starting location and original flight level after the spiral is completed.

*The following procedure should be used to select a location to safely complete the spiral ascent/descent:*

1. At typical P-3 flight altitudes (below the freezing level), assess whether a region **consists entirely of stratiform radar echo**, which can be determined using a combination of the lower fuselage Multi-mode Radar (MMR) and the tail Doppler radar (TDR):
  - a. The MMR should present a **uniform region of reflectivity**, indicative of stratiform rain, with **no cellular (convective) echoes within 20 n mi of the aircraft position**
  - b. The TDR sweeps should indicate **no high reflectivity (>40 dBZ) cores above the freezing level (bright band signature)**, which would suggest convective cores embedded within the stratiform region
2. A ground scientist should report to the scientist onboard the P-3 that **no lightning activity has been detected within the region in the previous 15 minutes**, using the detection networks available on the NASA Mission Tools Suite (MTS).

**EARLY STAGE EXPERIMENT**  
*Flight Pattern Descriptions*

3. This module may only be conducted in sufficient daylight to allow for visual inspection of aircraft surfaces to be conducted during the spiral.
4. If these conditions are met, that location should be marked, the airplane repositioned to that location, and the module completed as outlined above.



*Figure SSM1: P-3 Stratiform Spiral module: (a) Example spiral ascent and descent in stratiform portion of primary rainband. (b) Example spiral ascent and descent in isolated CB during stratiform transition.*

**Flight altitude:** The altitude should range from 5 kft to ~22 kft.

**Leg length or radii:** Spiral ascents and descents should maintain roll angle of 15–20° to confine spiral to limited geographical area, with an ascent or descent rate of ~5 m s<sup>-1</sup>.

**Estimated in-pattern flight duration:** 1 h added to the mission

**Expendable distribution:** A dropsonde should be released at the apex of any spiral ascents to provide a profile of thermodynamic structure over the depth of the spiral.

**Instrumentation Notes:** Cloud and precipitation imaging probes should be on and collecting data during the spiral ascents and descents.

**G-IV Pattern 1:** G-IV is not an explicit platform used with the module, science objectives of module will be enhanced if G-IV is flying coincident with P-3 and releasing dropsondes in close spatial and temporal proximity to P-3 during Stratiform Spiral module.